

# UTILITY PATENT APPLICATION TRANSMITTAL (Large Entity)

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Docket No.  
Intech 204-IJS

Total Pages in this Submission  
41

## TO THE ASSISTANT COMMISSIONER FOR PATENTS

Box Patent Application  
Washington, D.C. 20231

Transmitted herewith for filing under 35 U.S.C. 111(a) and 37 C.F.R. 1.53(b) is a new utility patent application for an invention entitled:

**METHOD FOR TRACKING THE LOCATION OF MOBILE UNITS**

and invented by:

Helena Zelmanovich, Victor Zelmanovich, George Bilenko

If a **CONTINUATION APPLICATION**, check appropriate box and supply the requisite information:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.: \_\_\_\_\_

Which is a:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.: \_\_\_\_\_

Which is a:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.: \_\_\_\_\_

Enclosed are:

### Application Elements

1. ☒ Filing fee as calculated and transmitted as described below
2. ☒ Specification having 20 pages and including the following:
  - a. ☒ Descriptive Title of the Invention
  - b. ☐ Cross References to Related Applications (if applicable)
  - c. ☐ Statement Regarding Federally-sponsored Research/Development (if applicable)
  - d. ☐ Reference to Microfiche Appendix (if applicable)
  - e. ☒ Background of the Invention
  - f. ☒ Brief Summary of the Invention
  - g. ☒ Brief Description of the Drawings (if drawings filed)
  - h. ☒ Detailed Description
  - i. ☒ Claim(s) as Classified Below
  - j. ☒ Abstract of the Disclosure

# UTILITY PATENT APPLICATION TRANSMITTAL (Large Entity)

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Docket No.  
Intech 204-IJS

Total Pages in this Submission  
41

## Application Elements (Continued)

3. ☒ Drawing(s) (when necessary as prescribed by 35 USC 113)

- a. ☒ Formal                      Number of Sheets 6
- b. ☐ Informal                      Number of Sheets \_\_\_\_\_

4. ☒ Oath or Declaration

- a. ☒ Newly executed (original or copy)      ☐ Unexecuted
- b. ☐ Copy from a prior application (37 CFR 1.63(d)) (for continuation/divisional application only)
- c. ☒ With Power of Attorney      ☐ Without Power of Attorney
- d. ☐ DELETION OF INVENTOR(S)  
Signed statement attached deleting inventor(s) named in the prior application,  
see 37 C.F.R. 1.63(d)(2) and 1.33(b).

5. ☐ Incorporation By Reference (usable if Box 4b is checked)

The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

6. ☐ Computer Program in Microfiche (Appendix)

7. ☐ Nucleotide and/or Amino Acid Sequence Submission (if applicable, all must be included)

- a. ☐ Paper Copy
- b. ☐ Computer Readable Copy (identical to computer copy)
- c. ☐ Statement Verifying Identical Paper and Computer Readable Copy

## Accompanying Application Parts

8. ☒ Assignment Papers (cover sheet & document(s))

9. ☐ 37 CFR 3.73(B) Statement (when there is an assignee)

10. ☐ English Translation Document (if applicable)

11. ☐ Information Disclosure Statement/PTO-1449      ☐ Copies of IDS Citations

12. ☐ Preliminary Amendment

13. ☒ Acknowledgment postcard

14. ☒ Certificate of Mailing

☐ First Class      ☒ Express Mail (Specify Label No.): EL455630700US

# UTILITY PATENT APPLICATION TRANSMITTAL (Large Entity)

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Docket No.  
Intech 204-IJS

Total Pages in this Submission  
41

## Accompanying Application Parts (Continued)

15. ☐ Certified Copy of Priority Document(s) (if foreign priority is claimed)

16. ☐ Additional Enclosures (please identify below):

## Fee Calculation and Transmittal

### CLAIMS AS FILED

For	#Filed	#Allowed	#Extra	Rate	Fee
Total Claims	16	- 20 =	0	x \$18.00	\$0.00
Indep. Claims	2	- 3 =	0	x \$78.00	\$0.00
Multiple Dependent Claims (check if applicable) <input type="checkbox"/>					\$0.00
BASIC FEE					\$760.00
OTHER FEE (specify purpose)					\$0.00
TOTAL FILING FEE					\$760.00

- ☐ A check in the amount of \_\_\_\_\_ to cover the filing fee is enclosed.
- ☒ The Commissioner is hereby authorized to charge and credit Deposit Account No. 19-3869 as described below. A duplicate copy of this sheet is enclosed.
- ☒ Charge the amount of \$760.00 as filing fee.
- ☒ Credit any overpayment.
- ☒ Charge any additional filing fees required under 37 C.F.R. 1.16 and 1.17.
- ☐ Charge the issue fee set in 37 C.F.R. 1.18 at the mailing of the Notice of Allowance, pursuant to 37 C.F.R. 1.311(b).

  
Signature

Ira J. Schaefer, Esq.  
Reg. No. 26,802  
Sprung Kramer Schaefer & Briscoe  
120 White Plains Road  
Suite 202  
Tarrytown, NY 10591-5534

Dated: August 26, 1999

CC:

914-332-5056

**CERTIFICATE OF MAILING BY "EXPRESS MAIL" (37 CFR 1.10)**Applicant(s): **Helena Zelmanovich, Victor Zelmanovich, George Bilenko**

Docket No.

**Intech 204-IJS**

Serial No.

To Be Assigned

Filing Date

Herewith

Examiner

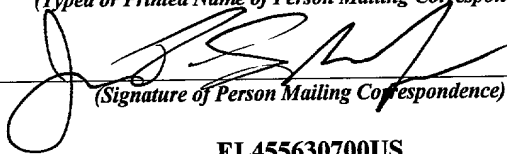
N/A

Group Art Unit

N/A

Invention: **METHOD FOR TRACKING THE LOCATION OF MOBILE UNITS**I hereby certify that this Utility Patent Application*(Identify type of correspondence)*

is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under  
37 CFR 1.10 in an envelope addressed to: The Assistant Commissioner for Patents, Washington, D.C. 20231 on

August 26, 1999*(Date)*Ira J. Schaefer*(Typed or Printed Name of Person Mailing Correspondence)**(Signature of Person Mailing Correspondence)*EL455630700US*("Express Mail" Mailing Label Number)***Note: Each paper must have its own certificate of mailing.**

[illegible][illegible]

## BACKGROUND OF THE INVENTION

The present invention relates to a method for tracking the location of mobile units.

There is currently a great need for the tracking of the location of mobile units, particularly wireless transmitters or transceivers that are worn or carried on a person, so as to keep track of that person's location. The mobile units also can have sensors which sense voltage, temperature, vital signs, etc., and thus it is also important for the mobile unit to be able to transmit this information under adverse conditions.

Many problems arise from the use of such units, particularly where many units are present in a given area, and there is a need to accurately identify each individual unit, as well as to accurately identify the location of the unit.

## SUMMARY OF THE INVENTION

The main object of the present invention is to provide a method for tracking the location of mobile units which is achieved by calculating the coordinates of the location of a mobile unit with a unique identification.

Another object of the present invention is to calculate the coordinates of the location of each mobile unit by measuring the phase difference of signals arriving at antenna elements of a phase array antenna at the base unit from a mobile unit.

Preferably, measuring of the phase difference is performed in the base unit, whereas the step of calculating the coordinates is performed in a main unit connected to the base unit and comprising a programmable computer, for example, an Intel Pentium II based personal computer having a Windows 98 operating system, or any kind of programmable computer system.

Each mobile unit may have one or more sensors, and the signal that is received from the mobile unit includes information or an information signal, may include an output from the sensor and a mobile unit address (identification number). The information from the sensor is processed preferably by the main unit.

The wireless transmitter or transceiver used in the mobile unit is preferably a radio frequency transmitter, and more preferably, a radio frequency transceiver.

Another object of the present invention is to improve the tracking method by a method for calibrating a system for tracking the location of mobile units.

Still another object of the present invention is to improve the accuracy of the location tracking by providing two or more base units disposed at a predetermined position apart from each other and measuring the azimuth of the signal received from each mobile unit at the antenna elements of the base units.

In accordance with the present invention, the base unit or phase difference measurement and communication unit (PDMCU)

has the phase array antenna for receiving signals from a plurality of mobile wireless transmitter units or portable wireless interfaces (PWI) and at least one reference wireless transmitter or beacon is disposed at a fixed location. The beacon is at a known location with regard to the base unit and has a unique identifying address which identifies it as a beacon or reference unit.

A signal including the address is received from the beacon at the base unit via the phase array antenna. The phase difference between the signal arriving at the antenna elements from the beacon is measured and the coordinates of the location of the beacon are then calculated. Future calculations can then be corrected by the difference between the calculated coordinates of the beacon and the actual location of the beacon. Thus, when calculations are performed thereafter for mobile units, similar corrections can be performed to the calculated coordinates in order to find the actual location of those mobile units.

To further increase accuracy of the location detection, a plurality of base units can be used. In this case, the locations of the base units are known and each base unit will measure the azimuth direction of the mobile unit.

These and other objects and advantages of the present invention are achieved in accordance with the present invention disclosed in detail hereinafter with reference to the attached



drawings, wherein

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

Fig. 1 is a block diagram of the system for carrying out the method of the present invention;

Fig. 2A is a drawing showing the method for calculating the polar coordinates;

Fig. 2B is a drawing showing the method for calculating the X,Y coordinates;

Fig. 3 is a drawing showing the calculation of the calibration corrections;

Fig. 4 is a block diagram of the mobile units of Fig. 1;

Fig. 5 is a block diagram of the beacon of Fig. 1;

Fig. 6 is a block diagram of the base units of Fig. 1;

Fig. 7 is a block diagram of the main unit of Fig. 1;

and

Fig. 8 is a drawing of a phase difference measurement circuit in the base unit.

#### **DETAILED DESCRIPTION OF THE INVENTION**

Referring now to Fig. 1, a system is shown for carrying out the method of the present invention for the detection of the location and identification of mobile units 40 by the use of a

phase array antenna 30.

The system may have a single base unit 20, but preferably has a plurality of addressable base units each with antenna elements in a phase antenna array 30. The base unit receives a signal from a mobile unit or beacon 50 at each antenna element. There will be a resulting phase difference and the function of the base unit is to measure the phase difference and communicate it to main unit 10. The function of the main unit is to process information from the base units and mobile units and communicate the information. The base units 20 are connected to the main unit or computation and communication module 10 in a hard-wired manner as shown in Fig. 1 or through a wireless connection. Moreover, while the base units 20 are shown to be connected in parallel, they can also be connected via a network to the main unit 10. While a single main unit is shown, it is understood that the system can include a plurality of main units each having base units connected thereto. In the various system configurations that have been described, each base unit has a unique address that is sent to the main unit with all transmissions and this unique address also permits each base unit to be addressable by the main unit.

The main unit 10 is preferably a programmed microcomputer, such as an Intel Pentium II based computer having Windows 98 operating system plus a network controller module which serves as an interface between the base units and the computer.

The base unit comprises a circuitry for measuring the phase difference of the signals arriving from the mobile units 40 or from a beacon 50, as well as having circuitry for information

data detection from each mobile unit 40 or beacon 50. The base units 20 also have the ability to communicate with the main unit 10, either by means for of a driver along a hard-wire line or by means of a radio transceiver for wireless communication.

The system also includes the aforementioned mobile or portable wireless interface units 40 of which any number can be used, as long as each has a unique address which it is capable of communicating to the base units 20. The mobile units include a transmitter, preferably a radio frequency transceiver, as well as any number of a set of sensors that can be used to make telemetry readings. The outputs of the sensors are communicated via the transmitters to base units and thereafter to the main unit so as to be processed therein.

The main unit 10, which is preferably a computation and communication module, as noted above, comprises a programmed personal computer and utilizes software for the portable wireless interface unit location calculation and database management for storing the sensor readings, along with the locations for each mobile unit 40.

The system also includes beacons 50 which are fixed location wireless transmitters or transceivers, whose location relative to the phase array antenna of the base units 20 are known to the main unit 10. The system can use one or more beacons 50, depending upon the environment, that is, if the signals therefrom would be blocked from the various phase array

antennas 30.

In accordance with the invention, once there is a measurement in the base unit 20 of the phase difference of the signal received from a mobile unit 40, the main unit 10 will calculate the coordinates of the location and process the data from the sensors.

The method according to the present invention combines the location and identification of any mobile unit by using multiple phase array antennas and transfers the collected information to an information management system in the main unit which can also collect and process the information from sensors attached to the mobile units 40.

Referring now to Fig. 2A, the calculation of the polar coordinates  $R$ ,  $\alpha$  of a tracked object is explained using the phase array antenna in a radio frequency identification type system.

As shown in Fig. 2A, O is the tracked object with a transmitter or transceiver and A, B and C are antenna elements. It has been found that the location can be determined by using just two antenna elements when at least two base units are used.

The base unit 20 measures the phase difference of points A,C relative to point B ( $\Delta\Phi_A$ ,  $\Delta\Phi_C$ ) electronically at points A and C respectively.

In accordance with the invention, the antenna elements can be positioned in such a way that, for example,  $\lambda/2$  or any needed distance for a particular application. For example

$$AB = BC = \frac{\lambda}{2} \quad \text{or}$$

$$AB = BC = \lambda$$

or any other desired value.

As a result

$$\Delta\Phi_A = \frac{2\pi AD}{\lambda}$$

$$\Delta\Phi_C = \frac{2\pi EC}{\lambda}$$

From these equations, if  $\Phi_A$  and  $\Phi_C$  are known, then the angles  $\theta_1$  and  $\theta_2$  can be calculated, as we can see from the following example.

If we assume that

$$AB = BC = \lambda$$

$$\lambda \ll OB$$

$$\lambda \ll OA$$

$$\lambda \ll OC$$

$$\Delta\Phi_A = 90^\circ = \frac{\pi}{2}$$

then

$$AD = \frac{\Phi_A \lambda}{2\pi} = \frac{\lambda}{4}$$

$$\cos\theta_1 = \frac{AD}{AB} = \frac{\lambda}{4\lambda} = \frac{1}{4}$$

$$\theta_1 = 75.5^\circ$$

Once angles  $\theta_1$  and  $\theta_2$  are known, then

OF=h

$$FC=x$$

$$AF= 2\lambda-x$$

$$h = x \tan \theta_2$$

$$h = (2\lambda - x) \tan \theta_1$$

$$x \tan \theta_2 = 2\lambda \tan \theta_1 - x \tan \theta_1$$

$$x(\tan \theta_1 + \tan \theta_2) = 2\lambda \tan \theta_1$$

$$x = \frac{2\lambda \tan \theta_1}{\tan \theta_1 + \tan \theta_2}$$

$$h = x \tan \theta_2$$

$$h = \frac{2\lambda \tan \theta_1 \tan \theta_2}{\tan \theta_1 + \tan \theta_2}$$

Then the radius vector R can be determined as follows

$$R = OB = \sqrt{(\lambda - x)^2 + h^2}$$

$$\tan \alpha = \frac{h}{\lambda - x}$$

The polar coordinates R,  $\alpha$  define the exact location of a tracked object at any given moment in time.

Multiple base units can measure the azimuth of the same mobile unit from different locations and transmit this information to the main unit. In this case, the main unit can provide better accuracy of the location coordinates for the mobile units.

The coordinate calculations for an object position using two phase array antennas, each with two antenna elements when the distance between the elements is  $\lambda/2$  is now explained with the help of Fig. 2B.

The following are known:  $B_1(x_0, 0)$ ,  $A_2(0, y_0)$ ,  $\theta_1$ ,  $\theta_2$ . The problem is to find  $O_1(x_1, y_1)$ .

$$\frac{y_1}{\frac{\lambda}{2} - (x_1 - x_0)} = \tan \theta_1$$

$$y_1 = \left(\frac{\lambda}{2} - x_1 + x_0\right) \tan \theta_1$$

$$y_1 = \left(\frac{\lambda}{2} + x_0\right) \tan \theta_1 - x_1 \tan \theta_1$$

$$\frac{x_1}{y_0 - y_1} = \tan \theta_2$$

$$x_1 = (y_0 - y_1) \tan \theta_2$$

$$x_1 = y_0 \tan \theta_2 - y_1 \tan \theta_2$$

$$y_1 = \left(\frac{\lambda}{2} + x_0\right) \tan \theta_1 - y_0 \tan \theta_1 \tan \theta_2 + y_1 \tan \theta_1 \tan \theta_2$$

$$y_1 = \frac{\tan \theta_1 \left(\frac{\lambda}{2} + x_0 - y_0 \tan \theta_2\right)}{1 - \tan \theta_1 \tan \theta_2}$$

$$x_1 = \tan \theta_2 \left[ y_0 - \frac{\tan \theta_1 \left(\frac{\lambda}{2} + x_0 - y_0 \tan \theta_2\right)}{1 - \tan \theta_1 \tan \theta_2} \right]$$

The last two equations represent the coordinates of the tracked object  $O_1$  by using two phase array antennas and are expressed through given quantities  $x_0$ ,  $y_0$ ,  $\theta_1$ ,  $\theta_2$ .

Fig. 3 shows how the beacon 50 can be used for the calibration of the radio frequency identification system.

One or more beacons are positioned in a constant position, so that the exact locations, that is, their

coordinates, are defined by the needed application and are known. In this example the polar coordinates are used, but it is understood that it is equally applicable to other coordinates.

$O_1$  and  $O_2$  and  $O_3$  are the actual positions of the beacon, whereas  $O'$ ,  $O''$  and  $O'''$  are points from which the electronic signals were calculated as being received.

A number of electronic measurements are taken for the position of the beacon. They are then averaged, and then one calculates the average of  $\Delta O_1$ ,  $\Delta O_2$  and  $\Delta O_3$  and the final average  $\Delta O$  will be used for calibration and accounted for in  $\Delta \Phi_A$  and  $\Delta \Phi_B$ .

BEACON AT	$R_{\text{BEACON}}$	$\alpha_{\text{BEACON}}$	SIGNAL FROM	DISPLACEMENT VECTOR
$O_1$	$R_1$	$\alpha_1$	$O'$	$\vec{O}'\vec{O}_1 = \Delta O_1$
$O_2$	$R_2$	$\alpha_2$	$O''$	$\vec{O}''\vec{O}_2 = \Delta O_2$
$O_3$	$R_3$	$\alpha_3$	$O'''$	$\vec{O}'''\vec{O}_3 = \Delta O_3$

Fig. 4 shows the details of the mobile unit 40. The unit includes a microprocessor 401 which receives inputs from one or more sensors 405 and which has a hard-wired address 402 which is unique and which is received by the microprocessor 401.

The microprocessor 401 controls transceiver 404 which communicates via antenna 403 with the base units 20. The microprocessor 401 controls the transceiver so as to transmit the sensor information, along with the address information, and to



receive polling information from the base units 20.

The details of the beacon 50 are shown in Fig. 5. The beacon 50 includes a microprocessor 501 which receives, as an input, a unique address from 502 which identifies the beacon as a reference source, as opposed to a portable wireless interface unit 40. The microprocessor 501 controls the transceiver 504 to transmit a reference signal, along with the address, via antenna 503. The beacon can also have a sensor connected to it.

The transceivers 404 and 504 can be an RFM TR3001 transceiver, a Linx TXN-315-LC transmitter of comparable device from Motorola, Airnet, Intellon or Proxim. Microprocessors 401 and 501 can be conventional Intel, Motorola microprocessors or others.

The sensors 405 can sense telemetry information such as current, flow, leakage, motion, pressure, smoke, temperature, vibration, vital signs, and voltage.

Fig. 6 shows the details of the base unit 20. This unit is controlled by a microprocessor 201 which receives, for example, the phase difference signals  $\Delta\Phi_A$  and  $\Delta\Phi_C$  from phase difference measurement circuit 204. The signals, along with the address data, are processed by the microprocessor which sends the address data to the address detector 202 to determine the source of the signal. The base unit also has a unique address which is stored in 205 and which is sent along with data to the main unit. The microprocessor 201 communicates with the main unit 10 via the

I/O 203. The I/O 203 can be either a UART for transmitting asynchronous data to the main unit 10, either in parallel, as shown in Fig. 1, or via a network, or it can be a transceiver transmitting the information including the address to and from the main unit via wireless communication.

Fig. 7 illustrates the main unit 10. The main unit 10, as noted above, can be a programmed microcomputer, including a microprocessor 101 and an I/O 103 which is managing the wired or wireless network with I/O 203 of the base unit 20. The main unit 10 also includes a database 102 in which the information from the sensors is stored, along with the location and identification of each mobile unit. The main unit has an address detector 104 which determines which base unit it is receiving data from. Microprocessors 101 and 201 can be conventional Intel, Motorola microprocessors or others.

Fig. 8 illustrates the phase difference measurement circuit 204 that is used to measure each phase difference. In the circuit shown, two antenna elements A and B are used and the phase difference  $\Delta\phi$  is measured and sent to microprocessor 201. The circuit has a voltage controlled oscillator and modulator 208 which is a surface acoustic wave or phase lock loop based. Data from the main unit 10 used to poll the mobile unit or beacon is input and passed through amplifier 213 to switch 209 which connects the signal to antenna elements A and B for transmission to the mobile units and/or beacons.

When a signal is received at the antenna elements A and B, the switch 209 is set in the receive position and the signals are passed through low noise amplifiers 214 to mixers 210 where the signals are mixed with an output from local oscillator 206, which is a surface acoustic wave or phase lock loop based oscillator by Temic or Atmel. The output of the mixers is received by intermediate frequency receivers 207 which are for example NE605 by Philips. The data demodulated from the signals are combined at 212 to improve gain and constitute the data out signal sent to the microprocessor 201. The directional signals are fed to phase difference detector 211 which is a 74HCT9046. The output is the phase difference sent to microprocessor 201.

It is understood that the embodiments described hereinabove are merely illustrative and are not intended to limit the scope of the invention. It is realized that various changes, alterations, rearrangements and modifications can be made by those skilled in the art without substantially departing from the spirit and scope of the present invention.

What is claimed is:

1. A method for tracking the location of mobile units, comprising the steps of:

providing a plurality of mobile units each having a wireless transmitter and a unique address and at least one stationary base unit having a phase array antenna with antenna elements;

receiving a signal including an address from at least one mobile unit at the at least one base unit via the phase array antenna;

measuring the phase difference of the signal arriving at the antenna elements of the phase array antenna from each mobile unit; and

calculating the coordinates of the location of each mobile unit as a function of the phase difference.

2. The method according to claim 1, wherein the step of measuring the phase difference is performed in the at least one base unit.

3. The method according to claim 2, wherein the step of calculating the coordinates is performed in a main unit connected to the at least one base unit.

4. The method according to claim 3, wherein each

mobile unit has at least one sensor and the signal includes an information signal from the at least one sensor and wherein the information signal is processed by the main unit.

5. The method according to claim 1, wherein the wireless transmitter is a transceiver.

6. The method according to claim 1, wherein the step of calculating the coordinates comprises calculating the polar coordinates of each mobile unit.

7. The method according to claim 1, comprising at least two base units disposed at a predetermined distance from each other and wherein the step of calculating the coordinates of each mobile unit comprises measuring the azimuth of the signal from a mobile unit received at each base unit and calculating the coordinates of the location of the mobile unit as a function of the azimuths.

8. The method according to claim 1, further comprising the step of providing at least one reference wireless transmitter disposed at a fixed location and having a unique identifying address and calibrating the accuracy of the calculation of the coordinates of the mobile units using the at least one reference transmitter.

9. The method according to claim 8, wherein the step of calibrating comprises measuring the phase difference between the signal arriving at each antenna element from the at least one reference transmitter, calculating the coordinates of the location of the at least one reference transmitter and correcting future calculations by the difference between the calculated coordinates of the at least one reference transmitter and the actual location of the at least one reference transmitter.

10. The method according to claim 8, wherein the at least one reference transmitter has at least one sensor.

11. The method according to claim 8, wherein the at least one reference transmitter is a transceiver.

12. A method for calibrating a system for tracking the location of mobile units, comprising the steps of:

providing at least one stationary base unit having a phase array antenna having antenna elements for receiving signals from a plurality of mobile wireless transmitter units and at least one reference wireless transmitter disposed at a fixed location and having a unique identifying address;

receiving a signal including an address from the at least one reference transceiver at the at least one base unit via the phase array antenna;

measuring the phase difference between the signal arriving at each antenna element from the at least one reference transmitter;

calculating the coordinates of the location of the at least one reference transmitter; and

correcting future calculations by the difference between the calculated coordinates of the at least one reference transmitter and the actual location of the at least one reference transmitter.

13. The method according to claim 12, wherein the step of measuring the phase difference is performed in the at least one base unit.

14. The method according to claim 13, wherein the step of calculating the coordinates is performed in a main unit connected to the at least one base unit.

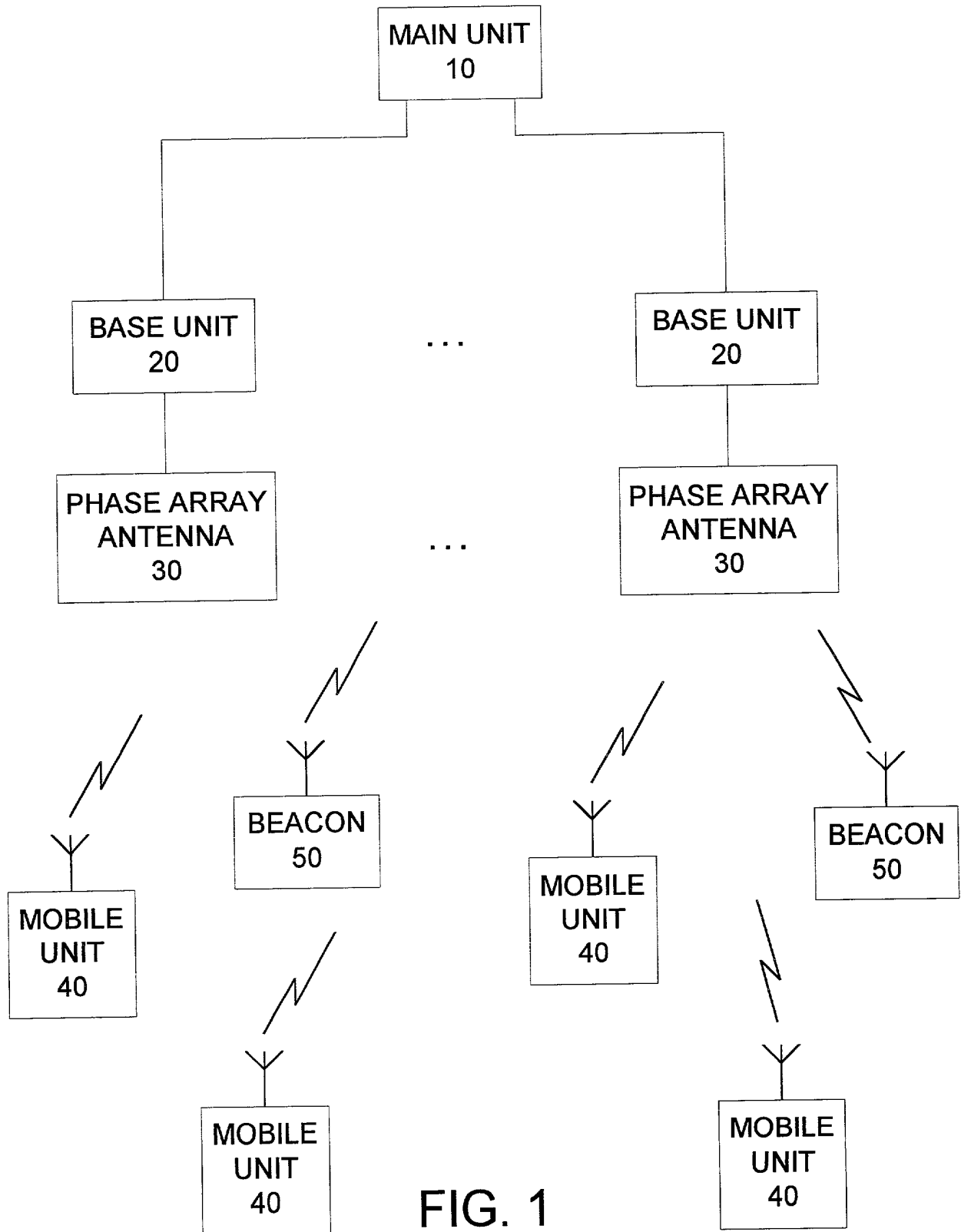
15. The method according to claim 12, wherein the wireless transmitter is a transceiver.

16. The method according to claim 12, wherein the calculated coordinates are polar coordinates.

## ABSTRACT OF THE DISCLOSURE

A method for tracking the location of mobile units, comprises providing a plurality of mobile units each having a wireless transmitter and a unique address and at least one stationary base unit having a phase array antenna with antenna elements. A signal including an address is received from at least one mobile unit by the at least base unit via the phase array antenna. The phase difference of the signal arriving at the antenna elements from each mobile unit is measured and the coordinates of the location of each mobile unit are calculated as a function of the phase differences.





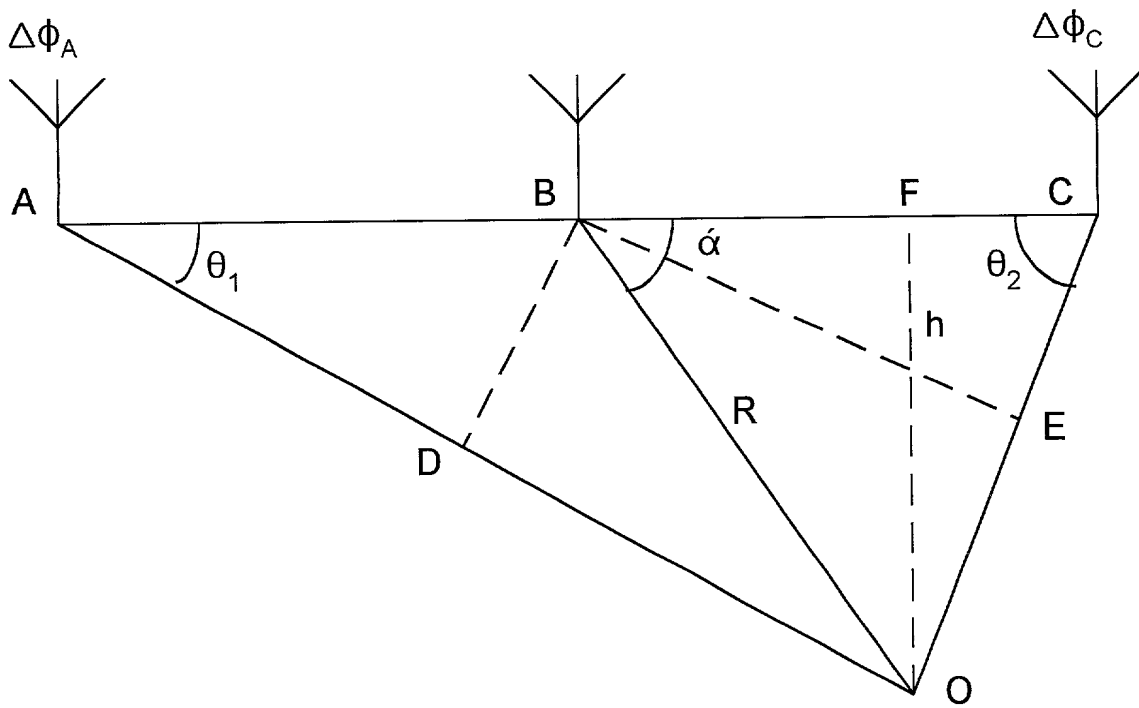


FIG. 2A

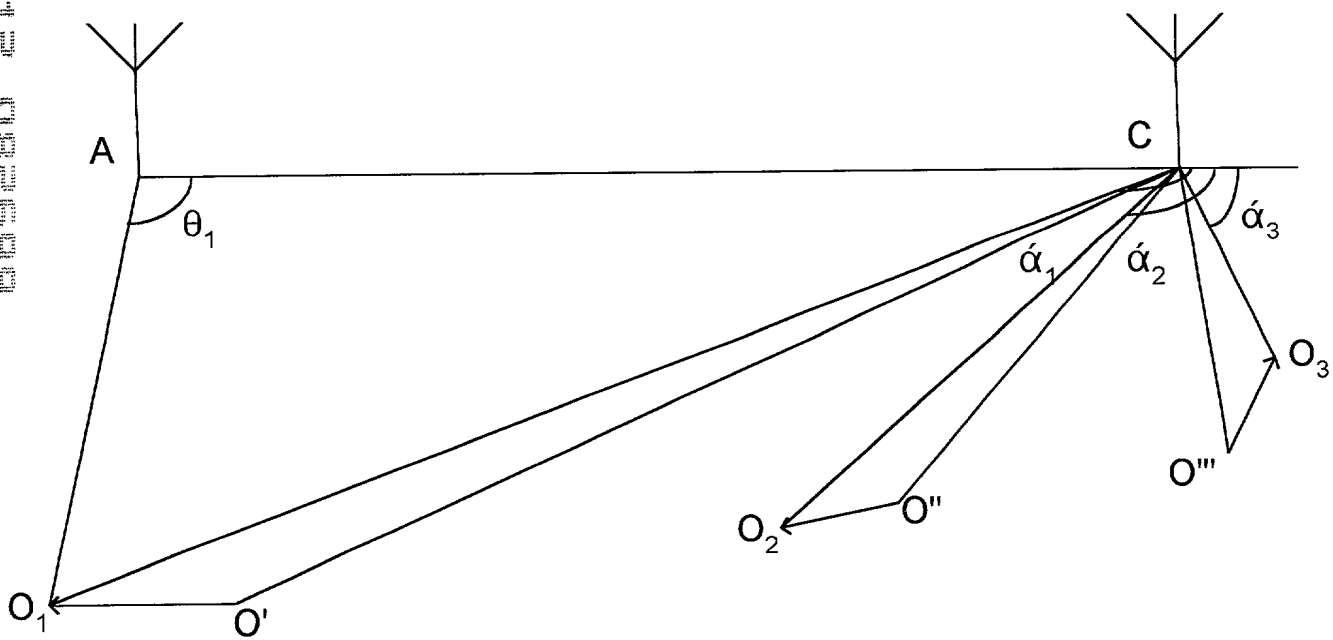


FIG. 3

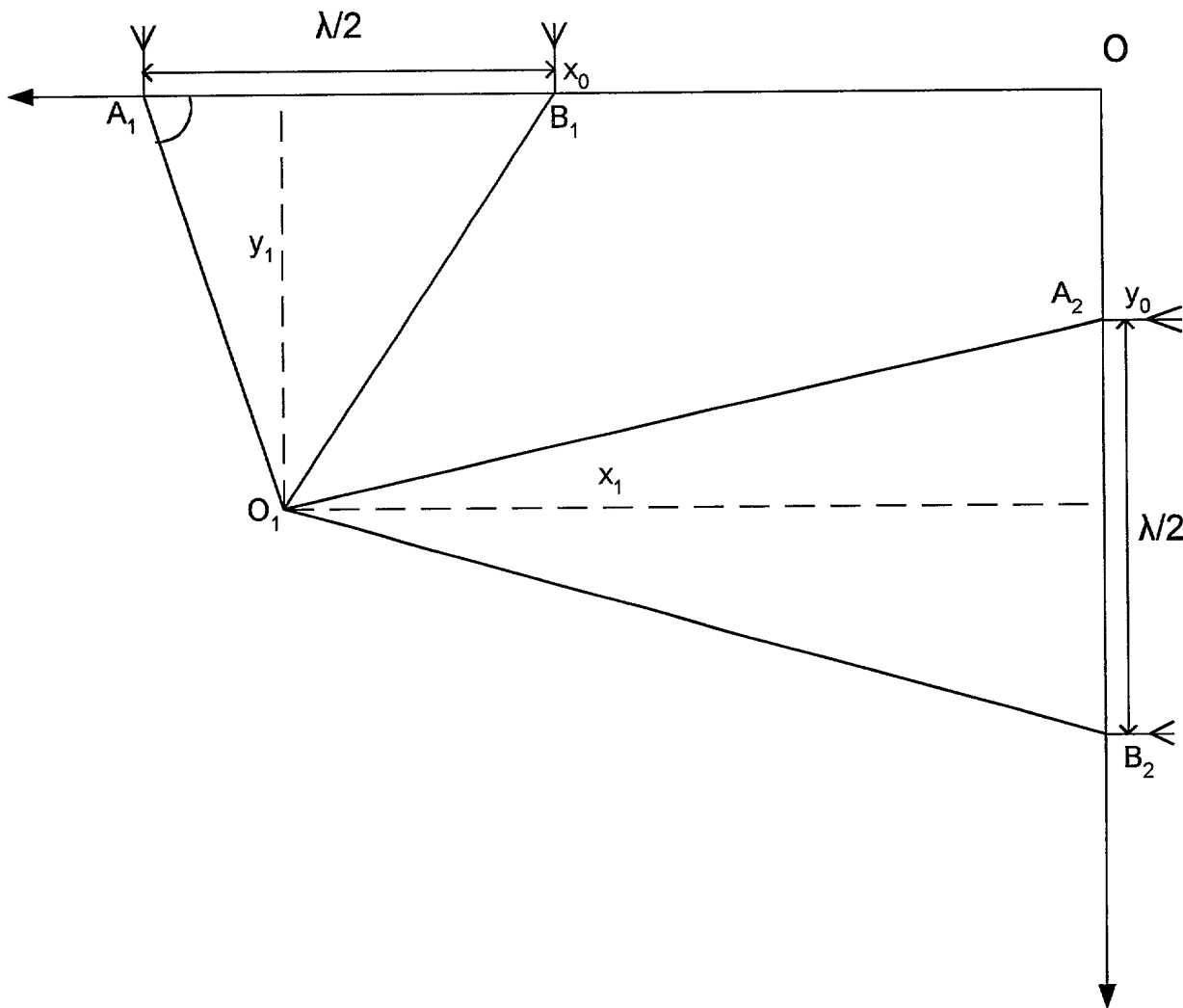


FIG. 2B

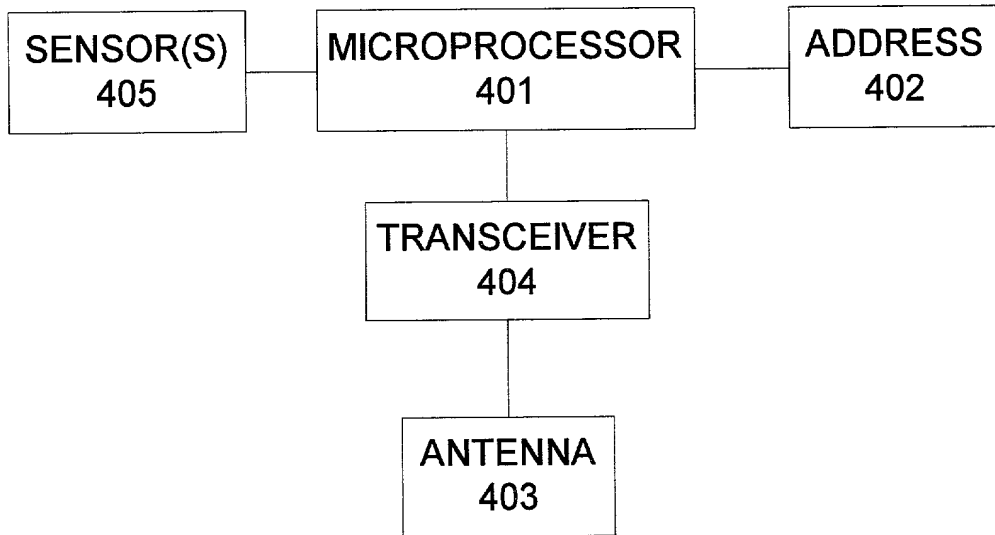


FIG. 4

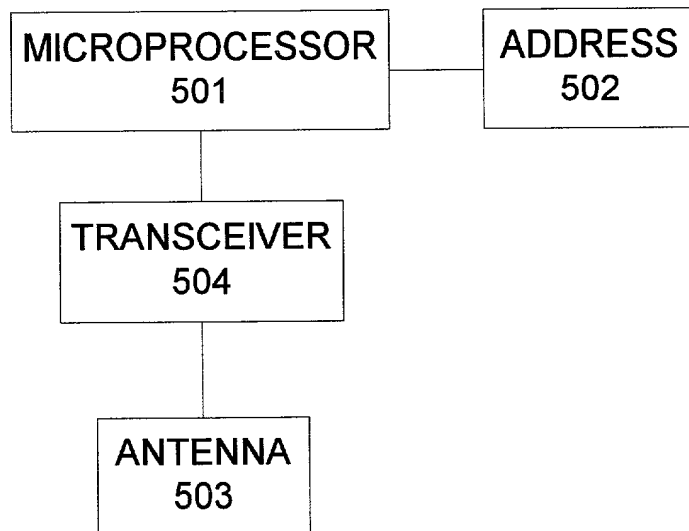


FIG. 5

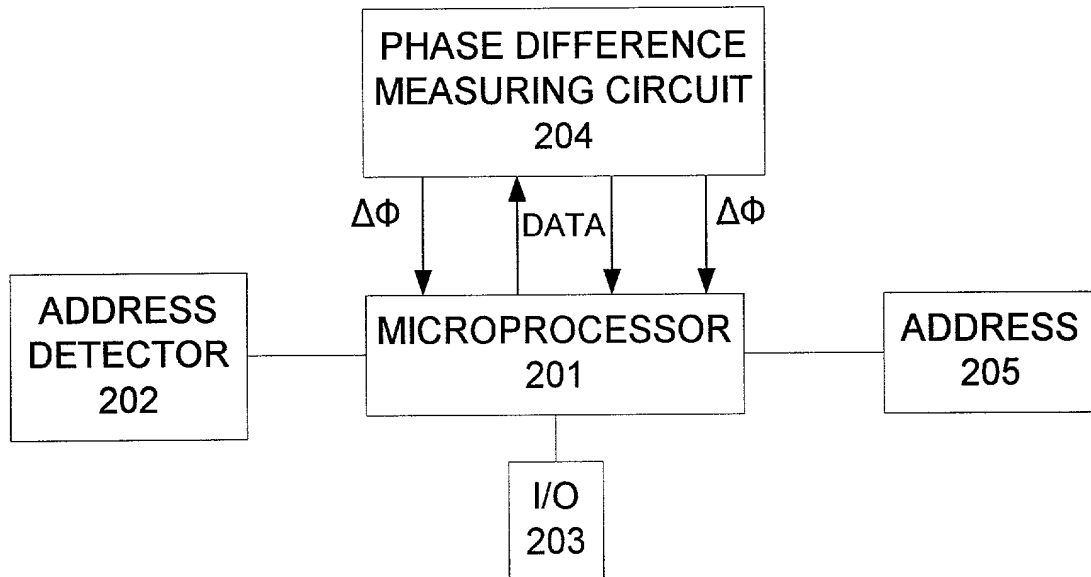


FIG. 6

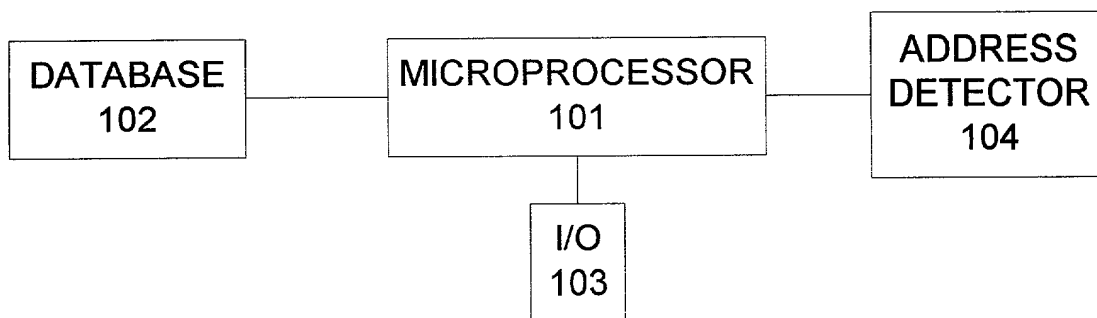


FIG. 7

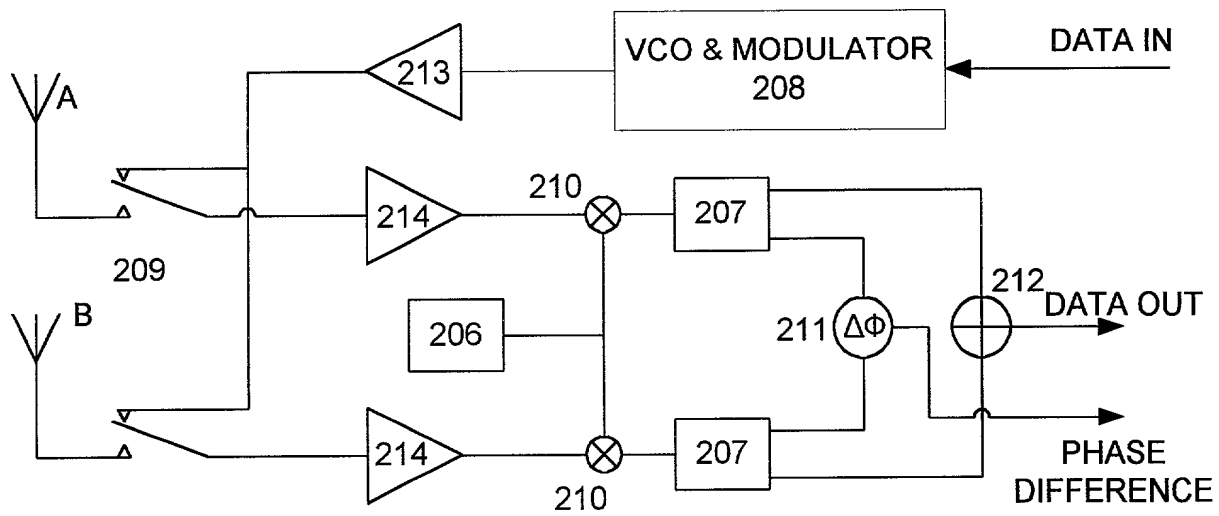


FIG. 8

Express Mail Label No. EL455630700US

Page 1 of 4

Docket No.  
Intech 204-IJS

# Declaration and Power of Attorney For Patent Application

## English Language Declaration

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

### METHOD FOR TRACKING THE LOCATION OF MOBILE UNITS

the specification of which

(check one)

☒ is attached hereto.

☐ was filed on \_\_\_\_\_ as United States Application No. or PCT International

Application Number \_\_\_\_\_

and was amended on \_\_\_\_\_

(if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

Priority Not Claimed

(Number)

(Country)

(Day/Month/Year Filed)

☐

(Number)

(Country)

(Day/Month/Year Filed)

☐

(Number)

(Country)

(Day/Month/Year Filed)

☐

I hereby claim the benefit under 35 U.S.C. Section 119(e) of any United States provisional application(s) listed below:

\_\_\_\_\_  
(Application Serial No.)

\_\_\_\_\_  
(Filing Date)

\_\_\_\_\_  
(Application Serial No.)

\_\_\_\_\_  
(Filing Date)

\_\_\_\_\_  
(Application Serial No.)

\_\_\_\_\_  
(Filing Date)

I hereby claim the benefit under 35 U. S. C. Section 120 of any United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. Section 112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, C. F. R., Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

\_\_\_\_\_  
(Application Serial No.)

\_\_\_\_\_  
(Filing Date)

\_\_\_\_\_  
(Status)  
(patented, pending, abandoned)

\_\_\_\_\_  
(Application Serial No.)

\_\_\_\_\_  
(Filing Date)

\_\_\_\_\_  
(Status)  
(patented, pending, abandoned)

\_\_\_\_\_  
(Application Serial No.)

\_\_\_\_\_  
(Filing Date)

\_\_\_\_\_  
(Status)  
(patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.



**POWER OF ATTORNEY:** As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(list name and registration number)*

Ira J. Schaefer

Reg. No. 26,802

Kurt G. Briscoe

Reg. No. 33,141

William C. Gerstenzang

Reg. No. 27,552

**Send Correspondence to:** Ira J. Schaefer, Esq.  
Sprung Kramer Schaefer & Briscoe  
120 White Plains Road, Suite 202  
Tarrytown, NY 10591-5534

**Direct Telephone Calls to:** *(name and telephone number)*

Ira J. Schaefer

Full name of sole or first inventor  
Helena Zelmanovich

Sole or first inventor's signature

Date

*Heleen - 8/26/99*

Residence

18 Stevenson Place, Deer Park, NY 11729

Citizenship

U.S.A.

Post Office Address

Same as above

Full name of second inventor, if any

Victor Zelmanovich

Second inventor's signature

Date

*Victor Zelmanovich 8.26.99*

Residence


18 Stevenson Place, Deer Park, NY 11729

Citizenship

U.S.A.

Post Office Address

Same as above

Full name of third inventor, if any <b>George Bilenko</b>	<b>8-26-99</b>
Third inventor's signature 	Date
Residence <b>212 Wardwell Street, Stamford, CT 06902</b>	
Citizenship <b>U.S.A.</b>	
Post Office Address <b>Same as above</b>	

Full name of fourth inventor, if any	
Fourth inventor's signature	Date
Residence	
Citizenship	
Post Office Address	

Full name of fifth inventor, if any	
Fifth inventor's signature	Date
Residence	
Citizenship	
Post Office Address	

Full name of sixth inventor, if any	
Sixth inventor's signature	Date
Residence	
Citizenship	
Post Office Address	